Chapter 4

The Three Rules of Deep Practice

Try again. Fail again. Fail better.
—Samuel Beckett

Adriaan de Groot and the HSE

Any discussion about the skill-acquiring process must begin by addressing a curious phenomenon that I came to know as the Holy Shit Effect. This refers to the heady mix of disbelief, admiration, and envy (not necessarily in that order) we feel when talent suddenly appears out of nowhere. The HSE is not the feeling of hearing Pavarotti sing or watching Willie Mays swing—they're one in a billion; we can easily accept the fact that they're different from us. The HSE is the feeling of seeing talent bloom in people who we thought were just like us. It's the tingle of surprise you get when the goofy neighbor kid down the street is suddenly lead guitarist for a successful rock band, or when your own child shows an inexplicable knack for differential calculus. It's the feeling of, where did *that* come from?

Traveling to talent hotbeds, I became plenty familiar with the HSE. First I would see young, cuddly kids (just like my kids!) trundling along to their classes, toting their cute baseball bats and tiny violins, making clumsy, endearing attempts at skill. They were just as unimpressive as you would expect children of that age to be. Then as the youngest kids departed and older kids started showing up, I witnessed a series of quantum leaps in skill level. Spending a few days at a hotbed was like walking down the hallway of a museum exhibition on the rise of the dinosaur. As if passing a series of dioramas, I encountered increasingly evolved species: the Pre-Teens (who were pretty darn good), the Mid-Teens (wow), and finally the Older Teenagers, who were velociraptors (take cover). The speed of the progression was stunning: each successive group was unimaginably stronger, faster, and more ferociously talented than the previous. Watching the change was like seeing an adorable gecko lizard morph into a slavering *T. Rex:* you know the two are related in theory, but that knowledge doesn't stop you from saying holy shit.

The interesting thing about the HSE is that it operates in one direction. The observer is dumbstruck, amazed, and bewildered, while the talent's owner is unsurprised, even blasé. This trick-mirror quality is not merely a case of diverging impressions—of willful naïveté on the observer's part or undue modesty on the talent-holder's part. It is a consistent perceptual pattern at the core of the skill-acquiring process, and it raises an important question: What's the nature of this process that creates two such wildly divergent realities? How can these people, who seem just like us, suddenly become talented while barely cognizant of how talented they've become? For the answer, we turn to a failed math teacher named Adriaan Dingeman de Groot.

De Groot, who was born in 1914, was a Dutch psychologist who played chess in his spare time. He experienced his own version of the HSE when a handful of players from his chess club, people just like him in age, experience, and background, nevertheless were able to perform superhuman feats of chess mastery. These were the sort of *T. Rex* players who could casually destroy ten opponents at once, blindfolded. Like Anders Ericsson decades later, de Groot puzzled over his losses, which led him to ask what exactly made these guys so great. At the time the scientific wisdom on the issue was unquestioned. It held that the best players possessed photographic memories that they used to absorb information and plan strategies. Master players succeeded, the theory went, because they were endowed with the cognitive equivalent of cannons, while the rest of us made do with popguns. But de Groot didn't buy this theory; he wanted to find out more.

To investigate, he set up an experiment involving both master players and more ordinary ones. De Groot placed chess pieces into positions from a real game, gave the players a five-second glimpse of the board, and then tested their recall. The results were what one might expect. The master players recalled the pieces and arrangements four to five times better than the ordinary players did. (World-class players neared 100 percent recall.)

Then de Groot did something clever. Instead of using patterns from a real chess game, he set the chess pieces in a random arrangement and reran the test. Suddenly the masters' advantage vanished. They scored no better than lesser players; in one case, a master chess player did worse than a novice. The master players didn't have photographic memories; when the game stopped resembling chess, their skills evaporated.

De Groot went on to show that in the first test, the masters

were not seeing individual chess pieces but recognizing patterns. Where novices saw a scattered alphabet of individual pieces, masters were grouping those "letters" into the chess equivalent of words, sentences, and paragraphs. When the pieces became random, the masters were lost—not because they suddenly became dumber but because their grouping strategy was suddenly useless. The HSE vanished. The difference between chess *T. Rexes* and ordinary players was not the difference between a cannon and a popgun. It was a difference of organization, the difference between someone who understood a language and someone who didn't. Or, to put it another way, the difference between an experienced baseball fan (who can take in a game with an ascertaining glance—runner on third, two out, bottom of the seventh inning) and the same fan at his first cricket match (who spends the game squinting bafflledly). Skill consists of identifying important elements and grouping them into a meaningful framework.The name psychologists use for such organization is *chunking*.

To get a feel for how chunking works, try to memorize these two sentences.

We climbed Mount Everest on a Tuesday morning.
Gn inromya Dseut Anotser ev e Tnuomde bmilcew.

The two sentences contain the same characters, just like de Groot's chessboards, except in the second sentence the order of those letters is reversed. The reason you can understand, recall, and manipulate the first sentence is that, like the chess masters or baseball fans, you have spent many hours learning and practicing a cognitive game known as reading. You've learned letter shapes and practiced chunking letters from left to right into discrete entities with deeper meanings—words—

and you've learned how to group those into still bigger chunks—sentences—that you can handle, move around, understand, and remember.

The first sentence is easy to remember because it has only three main conceptual chunks: "We climbed" is a chunk, "Mount Everest" is a chunk, and "Tuesday morning" is a chunk. Those chunks are in turn composed of smaller chunks. The letters *W* and *e* are both chunks that you combine into another chunk called *We*. The pattern of four diagonal lines forms a still smaller chunk that you recognize as a *W*. And so on—each group of chunks nests neatly inside another group like so many sets of Russian dolls. Your skill at reading, at its essence, is the skill of packing and unpacking chunks—or to put it in myelin terms, of firing patterns of circuits—at lightning speed.

Chunking is a strange concept. The idea that skill—which is graceful, fluid, and seemingly effortless—should be created by the nested accumulation of small, discrete circuits seems counterintuitive, to say the least. But a massive body of scientific research shows that this is precisely the way skills are built—and not just for cognitive pursuits like chess. Physical acts are also built of chunks. When a gymnast learns a floor routine, he assembles it via a series of chunks, which in turn are made up of other chunks. He's grouped a series of muscle movements together in exactly the same way that you grouped a series of letters together to form *Everest*. The fluency happens when the gymnast repeats the movements often enough that he knows how to process those chunks as one big chunk, the same way that you processed the above sentence. When he fires his circuits to do a backflip, the gymnast doesn't have to think, *Okay, I'm going to push off with my legs, arch my back, tuck my head into my shoulders, and bring my hips around,*

any more than you have to process each letter of *Tuesday*. He simply fires the backflip circuit that he's built and honed through deep practice.

When chunking has been done effectively, it creates a mirage that gives rise to the HSE. From below, top performers look incomprehensibly superior, as if they've leaped in a single bound across a huge chasm. Yet as de Groot showed, they aren't nearly so different from ordinary performers as they seem. What separates these two levels is not innate superpower but a slowly accrued act of construction and organization: the building of a scaffolding, bolt by bolt and circuit by circuit—or as Mr. Myelin might say, wrap by wrap.*

Rule One: Chunk It Up

We've seen how deep practice is all about constructing and insulating circuits. But practically speaking, what does that feel like? How do we know we're doing it?

Deep practice feels a bit like exploring a dark and unfamiliar room. You start slowly, you bump into furniture, stop, think, and start again. Slowly, and a little painfully, you explore the space over and over, attending to errors, extending your reach into the room a bit farther each time, building a mental map until you can move through it quickly and intuitively.

Most of us do a certain amount of this practicing reflexively.

* De Groot published his study in 1946 to zero acclaim. It was rediscovered twenty years later by Anders Ericsson's mentor, Nobel laureate Herbert Simon, who acknowledged de Groot as a pioneer of cognitive psychology and who in 1965 helped publish the work in English as *Thought and Choice in Chess*. De Groot went on to employ his findings in his own life, competing as a master chess player, publishing widely, and at age eighty-eight, recording a CD of classical piano improvisations.

The instinct to slow down and break skills into their components is universal. We heard it a billion times while we were growing up, from parents and coaches who echoed the old refrain "Just take it one step at a time." But what I didn't understand until I visited the talent hotbeds was just how effective that simple, intuitive strategy could be. In the talent hotbeds I visited, the chunking takes place in three dimensions. First, the participants look at the task as a whole—as one big chunk, the megacircuit. Second, they divide it into its smallest possible chunks. Third, they play with time, slowing the action down, then speeding it up, to learn its inner architecture. People in the hotbeds deep-practice the same way a good movie director approaches a scene—one instant panning back to show the landscape, the next zooming in to examine a bug crawling on a leaf in slo-mo. We'll look at each technique to see how it is deployed.

ABSORB THE WHOLE THING.

This means spending time staring at or listening to the desired skill—the song, the move, the swing—as a single coherent entity. People in the hotbeds stare and listen in this way quite a lot. It sounds rather Zen, but it basically amounts to absorbing a picture of the skill until you can imagine yourself doing it.

"We're prewired to imitate," Anders Ericsson says. "When you put yourself in the same situation as an outstanding person and attack a task that they took on, it has a big effect on your skill."

Imitation need not be conscious, and in fact it often isn't. In California I met an eight-year-old tennis player named Carolyn Xie, one of the top-ranked age-group players in the country. Xie had a typical tennis prodigy's game, except for one thing. Instead of the usual two-handed backhand for that

age, she hit one-handed backhands exactly like Roger Federer. Not a little bit like Federer but exactly like Federer, with that signature head-down, torero finish.

I asked Xie how she learned to hit that way. "I dunno," she said. "I just do." I asked her coach: he didn't know. Later Li Ping, Carolyn's mother, was chatting about their evening plans when she mentioned they'd be watching a tape of Roger's match. It turned out that everyone in the family was a huge fan of Federer; in fact, they had watched just about every televised match he'd ever played on tape. Carolyn in particular watched them whenever she could. In other words, in her short life she had seen Roger Federer hit a backhand tens of thousands of times. She had watched the backhand and, without knowing, simply absorbed the essence of it.*

Another example is Ray LaMontagne, a shoe-factory worker from Lewiston, Maine, who at age twenty-two had an epiphany that he should become a singer-songwriter. LaMontagne had little musical experience and less money, so he took a simple approach to learning: he bought dozens of used albums by Stephen Stills, Otis Redding, Al Green, Etta James, and Ray Charles, and holed up in his apartment. For two years. Every day he spent hours training himself by singing along to the records. LaMontagne's friends assumed he had left town; his neighbors assumed he was either insane or had locked himself inside a musical time capsule—which, in a sense, he had. "I would sing and sing, and hurt and hurt, because I knew I wasn't doing it right," LaMontagne said. "It

* W. Timothy Gallwey tells of a good example of imitation in his book *The Inner Game of Tennis*. When Gallwey was first teaching tennis in the 1960s, he decided to try an experiment: instead of talking to his beginner students, he would not speak a word, but simply show them how to hit. It worked surprisingly well, to the point that Gallwey was soon teaching fifty-year-old beginners to play passable games of tennis within twenty minutes without a single technical instruction.

took a long time, but I finally learned to sing from the gut." Eight years after he started, LaMontagne's first album sold nearly half a million copies. The main reason was his soulful voice, which *Rolling Stone* said sounded like church, and which other listeners mistook for that of Otis Redding and Al Green. LaMontagne's voice was a gift, it was agreed. But the real gift, perhaps, was the practice strategy he used to build that voice.

Some of the most fruitful imitation I saw took place at Spartak Tennis Club in Moscow, a freezing junkpile that has produced a volcano of talent: Anna Kournikova, Marat Safin, Anastasia Myskina, Elena Dementieva, Dinara Safina, Mikhail Youzhny, and Dmitry Tursunov. All in all, the club produced more top-twenty-ranked women than the United States did from 2005 to 2007, as well as half of the men's team that won the 2006 Davis Cup, and it's done all that with one indoor court. When I visited in December 2006, the club resembled a set for a *Mad Max* movie: shotgun shacks, diesel-shimmering puddles, and a surrounding forest filled with large, hungry, and disconcertingly speedy dogs. An abandoned eighteen-wheeler was parked out front. Walking up, I could see shapes moving behind clouded plastic windows, but I didn't hear that distinctive thwacking of tennis racquets and balls. When I walked in, the reason became evident: they were swinging all right. But they weren't using balls.

At Spartak it's called *imitatsiya*—rallying in slow motion with an imaginary ball. All Spartak's players do it, from the five-year-olds to the pros. Their coach, a twinkly, weathered seventy-seven-year-old woman named Larisa Preobrazhenskaya, roamed the court like a garage mechanic tuning an oversize engine. She grasped arms and piloted small limbs slowly through the stroke. When they finally hit balls—one by one, in a line (there are no private lessons at Spartak),

Preobrazhenskaya frequently stopped them in their tracks and had them go through the motion again slowly, then once more. And again. And perhaps one more time.

It looked like a ballet class: a choreography of slow, simple, precise motions with an emphasis on *tekhnika*—technique. Preobrazhenskaya enforced this approach with an iron decree: none of her students was permitted to play in a tournament for the first three years of their study. It's a notion that I don't imagine would fly with American parents, but none of the Russian parents questioned it for a second. "Technique is *everything*," Preobrazhenskaya told me later, smacking a table with Khrushchev-like emphasis, causing me to jump and speedily reconsider my twinkly-grandma impression of her. "If you begin playing without technique, it is big mistake. Big, big mistake!"

BREAK IT INTO CHUNKS.

The place I visited that best displayed this process was the Meadowmount School of Music in upstate New York. Meadowmount is located a five-hour drive north of Manhattan in the green quilt of the Adirondack Mountains. Its founder, renowned violin teacher Ivan Galamian, chose this site for the same reason New York State builds most of its prisons in this area: it's remote, inexpensive, and extremely quiet. (Galamian had first settled the camp in nearby Elizabethtown but deemed the local girls to be too distractingly beautiful, a point he underlined by marrying one.)

The original camp comprised a few cabins and an old house that had no electricity, no running water, and no television or telephone service. Since then, little has changed. The grounds, while lovely, are basic: students sleep in spartan dorms, and individual practice cabins teeter on supports made of tree stumps, cinderblocks, and in several cases a jack taken

from a nearby car. Meadowmount, however, is better defined by the camp's storied alumni (Yo-Yo Ma, Pinchas Zuckerman, Joshua Bell, and Itzhak Perlman) and, at its core, by a simple equation that has become the school's de facto motto: in seven weeks, most students will learn a year's worth of material, an increase of about 500 percent in learning speed. Among the students, this acceleration is well known but only dimly understood. So it's often spoken about as if it were some kind of snowboarding trick.

"Oh my God, that girl is totally gnarly," said David Ramos, sixteen, as he pointed out Tina Chen, a Chinese student who had recently performed a Korngold violin concerto at one of Meadowmount's nightly concerts. Ramos's voice dropped to an incredulous whisper. "She said she learned it in three weeks—but somebody else told me she really did it in *two*."

These feats are routine at Meadowmount, in part because the teachers take the idea of chunking to its extreme. Students scissor each measure of their sheet music into horizontal strips, which are stuffed into envelopes and pulled out in random order. They go on to break those strips into smaller fragments by altering rhythms. For instance, they will play a difficult passage in dotted rhythm (the horses' hooves sound—*da-dum, da-dum*). This technique forces the player to quickly link two of the notes in a series, then grants them a beat of rest before the next two-note link. The goal is always the same: to break a skill into its component pieces (circuits), memorize those pieces individually, then link them together in progressively larger groupings (new, interconnected circuits).

SLOW IT DOWN.

At Meadowmount jagged bursts of notes are stretched into whale sounds. One teacher has a rule of thumb: if a passerby

can recognize the song being played, it's not being practiced correctly. When camp director Owen Carman teaches a class, he spends three hours covering a single page of music. New students are surprised at the seemingly glacial pace—it's three or five times slower than they've ever gone. But when they're finished, they have learned to play the page perfectly; such a Clarissa-like feat would otherwise take them a week or two of shallower practice.*

Why does slowing down work so well? The myelin model offers two reasons. First, going slow allows you to attend more closely to errors, creating a higher degree of precision with each firing—and when it comes to growing myelin, precision is everything. As football coach Tom Martinez likes to say, "It's not how fast you can do it. It's how slow you can do it correctly." Second, going slow helps the practicer to develop something even more important: a working perception of the skill's internal blueprints—the shape and rhythm of the interlocking skill circuits.

For most of the last century, many educational psychologists believed that the learning process was governed by fixed factors like IQ and developmental stages. Barry Zimmerman, a professor of psychology at City University of New York, has never been one of them. Instead, he's fascinated by the kind of learning that goes on when people observe, judge, and strategize their own performance—when they, in essence, coach themselves. Zimmerman's interest in this type of learning, known as *self-regulation,* led him in 2001 to undertake an experiment that sounds more like a street-magic stunt than

* A nice description of this effect, and of deep practice in general, comes from Abraham Lincoln's portrayal of his own learning process. "I am slow to learn and slow to forget what I have learned," Lincoln wrote. "My mind is like a piece of steel, very hard to scratch anything on it and almost impossible after you get it there to rub it out."

regular science. Working with Anastasia Kitsantas of George Mason University, Zimmerman posed a question: Is it possible to judge ability solely by the way people describe the way they practice? To take, for instance, a roomful of ballerinas of varying ability, query them about demi-pliés, and then accurately pick out the best dancer, second-best dancer, third-best dancer, and so on, based not on their performance but solely on how they talked about practicing those demi-pliés?

The skill Zimmerman and Kitsantas chose was a volleyball serve. They gathered a range of expert players, club players, and novices, and asked them how they approached the serve: their goals, planning, strategy choices, self-monitoring, and adaptation—twelve measures in all. Using the answers, they predicted the players' relative skill levels, then had the players execute their serve to test the accuracy of their predictions. The result? Ninety percent of the variation in skill could be accounted for by the players' answers.

"Our predictions were extremely accurate," Zimmerman said. "This showed that experts practice differently and far more strategically. When they fail, they don't blame it on luck or themselves. They have a strategy they can fix."

In other words, the volleyball experts are like de Groot's *T. Rex* chess players. Through practice, they had developed something more important than mere skill; they'd grown a detailed conceptual understanding that allowed them to control and adapt their performance, to fix problems, and to customize their circuits to new situations. They were thinking in chunks and had built those chunks into a private language of skill.

When I was at Meadowmount, I met a fourteen-year-old cellist named John Henry Crawford, who gave me one of the most useful descriptions of what deep practice feels like that I have heard. He was hanging out by himself in a decrepit garage that held one of Meadowmount's few concessions to leisure: a broken-down Ping-Pong table. Crawford talked about the feeling of acceleration he got at Meadowmount, which he called "clicking in."

"Last year it took me almost the whole seven weeks to click in and start practicing well," he said. "This year I can feel it happening already. It's a thought thing."

We started rallying; John Henry spoke with the rhythm of the ball.

"When I click in, every note is being played for a purpose. It feels like I'm building a house. It feels like, this brick goes here, that one goes there, I connect them and get a foundation. Then I add the walls, connect those. Then the roof, then the paint. Then, hopefully, it all hangs together."

We played a game. It was close for a while, then I went ahead 20–17. Then John Henry hit five straight killshots to win.

"What can I say?" He shrugged apologetically. "I guess I'm getting good at building this house too."

Rule Two: Repeat It

We're all familiar with the adage that practice is the best teacher. Myelin casts the truth of this old saying in a new light. There is, biologically speaking, no substitute for attentive repetition. Nothing you can do—talking, thinking, reading, imagining—is more effective in building skill than executing the action, firing the impulse down the nerve fiber, fixing errors, honing the circuit.

One way to illustrate this truth is through a riddle: What's

the simplest way to diminish the skills of a superstar talent (short of inflicting an injury)? What would be the surest method of ensuring that LeBron James started clanking jump shots, or that Yo-Yo Ma started fudging chords?

The answer: don't let them practice for a month. Causing skill to evaporate doesn't require chromosomal rejiggering or black-ops psychological maneuvers. It only requires that you stop a skilled person from systematically firing his or her circuit for a mere thirty days. Their muscles won't have changed; their much-vaunted genes and character will remain unaltered; but you will have touched their talent at the weakest spot in its armor. Myelin, as Bartzokis reminds us, is living tissue. Like everything else in the body, it's in a constant cycle of breakdown and repair. That's why daily practice matters, particularly as we get older. As Vladimir Horowitz, the virtuoso pianist who kept performing into his eighties, put it, "If I skip practice for one day, I notice. If I skip practice for two days, my wife notices. If I skip for three days, the world notices."

Repetition is invaluable and irreplaceable. There are, however, a few caveats. With conventional practice, more is always better: hitting two hundred forehands a day is presumed to be twice as good as hitting one hundred forehands a day. Deep practice, however, doesn't obey the same math. Spending more time is effective—but only if you're still in the sweet spot at the edge of your capabilities, attentively building and honing circuits. What's more, there seems to be a universal limit for how much deep practice human beings can do in a day. Ericsson's research shows that most world-class experts—including pianists, chess players, novelists, and athletes—practice between three and five hours a day, no matter what skill they pursue.

People at most of the hotbeds I visited practiced less than

three hours a day. The younger Spartak kids (ages six to eight) practiced a mere three to five hours each week, while older teens ratcheted up to fifteen hours a week. The Little League baseballers of Curaçao, some of the world's best, play only seven months a year, usually three times a week. There were some exceptions—Meadowmount, for instance, insists on five hours of daily practice for its seven-week course. But on the whole the duration and frequency of practice in hotbeds seemed reasonably sane, proving what I saw in Clarissa's practices of "Golden Wedding" and "The Blue Danube": when you depart the deep-practice zone, you might as well quit.*

This jibes with what tennis coach Robert Lansdorp has witnessed. Lansdorp, who's in his sixties, is to tennis coaching what Warren Buffett is to investing, having worked with Tracy Austin, Pete Sampras, Lindsay Davenport, and Maria Sharapova. He is amused by the need of today's tennis stars to hit thousands of groundstrokes every day.

"You ever watch Connors practice? You ever watch McEnroe or Federer?" Lansdorp asks. "They didn't hit a thousand; most of them barely practice for an hour. Once you get timing, it doesn't go away."

Intrigued, I excitedly started to explain to Lansdorp about myelin—how it insulates circuits, how it grows slowly when we fire those circuits, how it takes ten years to get to world-class. I got about twenty seconds into my explanation when Lansdorp cut me off.

"Sure, of course," he said, nodding with the lordly style of someone who knows myelin more intimately than a neurologist ever could. "It has to be something like that."

*Another sign that the teachers look for is snoring. Deep practice tends to leave people exhausted: they can't maintain it for more than an hour or two at a sitting (a finding Ericsson has observed across many disciplines).

Rule Three: Learn to Feel It

The summer I visited Meadowmount they offered a new course called "How to Practice," taught by Skye Carman, the sister of school director Owen Carman. Half a dozen teens filed into a small practice cabin. Skye, an ebullient personality and former concertmaster of the Holland Symphony, began by asking, "How many of you practice five or more hours a day?"

Four raised their hands.

Skye shook her head in disbelief. "Good for you. I could have never done that, not in a million billion years. See, I hate to practice! *Hate, hate, hate!* So what I did, I forced myself to make it as productive as it could be. So here's what I want to know. What's the first thing you do when you practice?"

They stared at her incomprehendingly.

"Tune. Play some Bach," a tall boy said finally. "I guess."

"Hmmmm," Skye said, raising her eyebrow, illuminating their lack of strategy. "Let me see. I'll bet you all just . . . play! I'll bet you tune, pick a piece you like, and start fooling with it. Like picking up a ball."

They nodded. She had them nailed.

"That's crazy!" she said, flinging her arms in the air. "Do you think athletes do that? Do you think they just fool around? You guys have to realize this is top sport. You *are* athletes. Your playing field is a few inches long, but it still is your field. You need to find a place to stand, know where you are. First, tune your instrument. *Then* tune your ear."

The point, Skye explained, is to get a balance point where you can sense the errors when they come. To avoid the mistakes, first you have to feel them immediately.

"If you hear a string out of tune, it should *bother* you," Skye told them. "It should bother you a *lot*. That's what you need to feel. What you're really practicing is concentration. It's a feeling. So now we're going to practice that feeling."

They closed their eyes, and she played an open string. Then she twisted a tuning peg a fraction of a millimeter, and the sound changed. Their smooth brows wrinkled, and their expressions turned irritated, faintly hungry for her to fix it. Skye smiled.

"There," she said quietly. "Remember that."

Myelin is sneaky stuff. It's not possible to sense myelin growing along your nerve fibers any more than you can sense your heart and lungs becoming more efficient after a workout. It is possible, however, to sense the telltale set of secondary feelings associated with acquiring new skills—the myelin version of "feeling the burn."

As I traveled to various talent hotbeds, I asked people for words that described the sensations of their most productive practice. Here's what they said:

Attention

Connect

Build

Whole

Alert

Focus

Mistake

Repeat

Tiring

Edge

Awake*

This is a distinctive list. It evokes a feeling of reaching, falling short, and reaching again. It's the language of mountain climbers, describing a sensation that is stepwise, incremental, connective. It's the feeling of straining toward a target and falling just short, what Martha Graham called "divine dissatisfaction." It's the feeling Glenn Kurtz writes about in his book *Practicing:* "Each day, with every note, practicing is the same task, this essential human gesture—reaching out for an idea, for the grandeur of what you desire, and feeling it slip through your fingers."

It's a feeling that brings to mind Robert Bjork's idea of the sweet spot: that productive, uncomfortable terrain located just beyond our current abilities, where our reach exceeds our grasp. Deep practice is not simply about struggling; it's about seeking out a particular struggle, which involves a cycle of distinct actions.

1. Pick a target.
2. Reach for it.
3. Evaluate the gap between the target and the reach.
4. Return to step one.

* Here is a list of words I didn't hear: *natural, effortless, routine, automatic.* Another word that's not used around the talent hotbeds I visited was *genius.* Not that geniuses don't exist: the teachers I spoke with pegged the genius rate at about one per decade. "Very occasionally we'll get a super-top genius talent. I have no idea how their brains function," said Meadowmount's Skye Carman. "But it's a tiny, tiny percentage. The rest of us mortals have to work at it."

Judging by the facial expressions I saw in talent hotbeds, the sweet spot might better be named the bittersweet spot. And yet that taste, like all others, can be acquired. One of the useful features of myelin is that it permits any circuit to be insulated, even those of experiences we might not enjoy at first. At Meadowmount, instructors routinely see students develop a taste for deep practice. They don't like it at first. But soon, they say, the students begin to tolerate and even enjoy the experience.

"Most kids accelerate their practice fairly quickly," said Meadowmount director Owen Carman. "I think of it as a turn inward; they stop looking outside for solutions and they reach within. They come to terms with what works and what doesn't. You can't fake it, you can't borrow, steal, or buy it. It's an honest profession."

Meadowmount teachers hawkeye the students for telltale signs: hieroglyphs of notes scribbled on the sheet music, a new intensity to the conversations, a fresh reverence for the warm-up routines. Sally Thomas, a violin teacher, watches for changes in the way they walk. "They show up here with a strut," Thomas said. "Then after a while they aren't strutting anymore. That's a good thing."

A larger-scale example of this phenomenon occurs in Japanese schools. According to a 1995 study, a sample of Japanese eighth graders spent 44 percent of their class time inventing, thinking, and actively struggling with underlying concepts. The study's sample of American students, on the other hand, spent less than 1 percent of their time in that state. "The Japanese want their kids to struggle," said Jim Stigler, the UCLA professor who oversaw the study and who cowrote *The Teaching Gap* with James Hiebert. "Sometimes the [Japanese] teacher will purposely give the wrong answer so the kids

can grapple with the theory. American teachers, though, worked like waiters. Whenever there was a struggle, they wanted to move past it, make sure the class kept gliding along. But you don't learn by gliding."

Of all the images that communicate the sensation of deep practice, my favorite is that of the staggering babies. Long story short: a few years ago a group of American and Norwegian researchers did a study to see what made babies improve at walking. They discovered that the key factor wasn't height or weight or age or brain development or any other innate trait but rather (surprise!) the amount of time they spent firing their circuits, trying to walk.

However well this finding might support our thesis, its real use is to paint a vivid picture of what deep practice feels like. It's the feeling, in short, of being a staggering baby, of intently, clumsily lurching toward a goal and toppling over. It's a wobbly, discomfiting sensation that any sensible person would instinctively seek to avoid. Yet the longer the babies remained in that state—the more willing they were to endure it, and to permit themselves to fail—the more myelin they built, and the more skill they earned. The staggering babies embody the deepest truth about deep practice: to get good, it's helpful to be willing, or even enthusiastic, about being bad. Baby steps are the royal road to skill.

2

Ignition